Photo-Based Method for Collecting Fish Length Data of Coastal Tuna in Sri Lanka

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Abstract

Sri Lanka, as an island nation, possesses tuna fishery resources with high species diversity. Among them, coastal tuna species such as Kawakawa (*Euthynnus affinis*), bullet tuna (*Auxis rochei*), and frigate tuna (*Auxis thazard*) play a vital role in the fisheries industry while also serving as an essential source of daily protein for local communities. Therefore, obtaining accurate fish length data for these species is crucial to monitor the resources and manage them in a sustainable manner. However, collecting reliable data has been a challenge in the ongoing data collection programs. To address this, a practical method was developed using a photo-based application to collect fish length data. A field-friendly measuring board was designed, allowing fish to be placed on it and photographed. The photographs are then uploaded to a web-based application along with essential information such as date, landing site, and boat number, which can be linked to other fishery data collected in the field. The images are analyzed using the software *Fish-Mesh 2*, which measures fish lengths, while species identification is carried out manually. The results can be exported as Excel files and used for length-based analysis of small coastal tuna species. This newly developed method provides a quick, accurate, and reliable tool for obtaining fish length data to support sustainable fisheries management.

Key words: Coastal tuna, fish length data, photo-based method, Sri Lanka

Introduction

As a valuable living resource and due to high demand, it is essential to monitor tuna scientifically. Fish length data is particularly important, as it contributes to stock assessment, growth and age determination, reproductive information, and the monitoring of overfishing and ecosystem health (Kell and Sharma,2023; Zhang et al.,2021). Therefore, fisheries scientists worldwide collect fish length data to understand these critical factors, ensuring both the health of marine ecosystems and the sustainable use of resources in the fishing industry. However, collecting reliable data is both essential and challenging for several reasons. Many fishing nations conduct data collection programs to gather fishery-dependent data, including fish length measurements (De Graaf, 2011).

Yet, errors can occur due to the handling of fish during measurement, and sometimes the reliability of length data is questionable, especially when third parties are involved in the collection process.

Coastal tuna species are important food sources for local communities, and many coastal populations depend on these species for their livelihoods (Hidayat et al.,2011; Perera, Maldeniya and Bandaranayake, 2014). Sri Lanka hosts several coastal tuna species, including bullet tuna (*Auxis rochei*), frigate tuna (*Auxis thazard*), kawakawa (*Euthynnus affinis*), and small tunas like striped bonito, which play a significant role in coastal fishing operations. Consequently, collecting fish length data is a vital tool for monitoring and ensuring the sustainable utilization of these resources. Currently, NARA and the Department of Fisheries jointly operate a fishery-dependent data collection program with technical support from the Institute of Marine Research, Norway. Under this program, data are collected at fishing landing sites, including harbors, following a simple random stratified sampling plan. Enumerators are instructed to collect fish length data, particularly for tuna species, not only for scientific analysis but also to submit the data to the Indian Ocean Tuna Commission, a mandatory process. To improve reliability and efficiency, a method using photographs captured in the field has been introduced, allowing the collection of a larger number of fish length measurements at once accurately.

Methodology

Background of the method

The method consists of a fish measuring board made from an adjustable wooden frame covered with a canvas sheet that can be wrapped around the board when not in use. The adjustable wooden frame is designed to bend and be fastened using screws. The canvas sheet, which can be wrapped around the folded frame, is fixed to one arm of the wooden structure. When the frame is assembled into a square shape, the sheet is attached to the opposite arm, forming a firm measuring board. This setup is prepared at the sampling site, where fish specimens are placed on the board. Photographs of the fish on the board are then captured using a camera positioned perpendicularly above the surface.

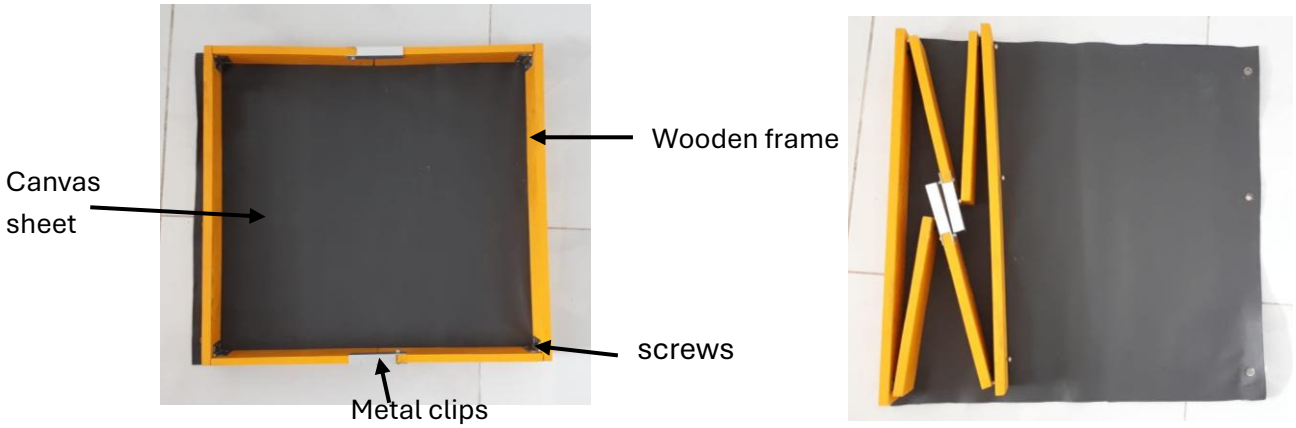

Fig.1. The image of the length board (size 60*60 cm^2) and the length board with folded wooden frame

The captured images are uploaded to a web-based application developed using PHP and JavaScript. This system streamlines image collection and storage process. Enumerators can upload high-definition (HD) images directly from field locations using secure individual logins. Each image is automatically tagged with metadata such as location, date, and time, ensuring accurate and traceable data logging for research and analysis. The system allows batch uploads of up to ten images at a time and includes a built-in duplicate detection feature to prevent redundant data storage, thereby maintaining database quality. Administrative users can access and download the uploaded images for further analysis, reporting, and archiving. Access privileges are restricted to administrators to ensure data security and controlled information management.

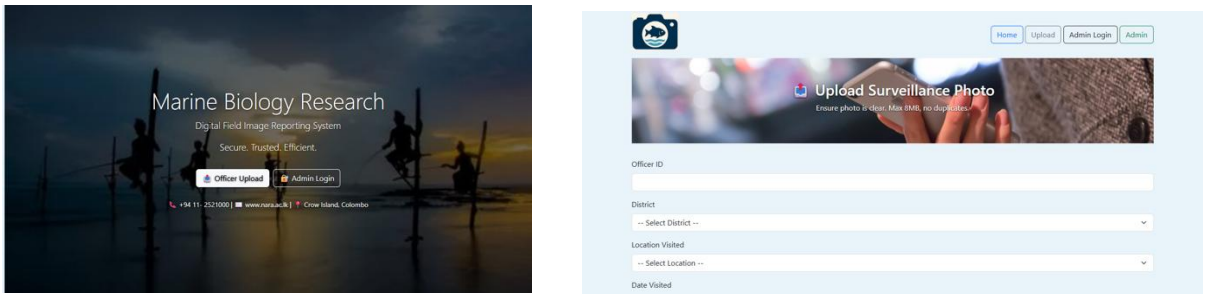

Fig.2.Images of the dashboard of the web-based application

The images obtained through the web application are then saved on a computer and analyzed using the FishMesh-2 software. Images are uploaded to the software through the “browse files” option. Before analysis, the board length is entered into the software settings. The yellow square appearing on the screen should be aligned with the inner margin of the measuring board in the image. Measurements are taken in the measurement window by drawing a yellow line from the tip of the snout to the upper tip of the caudal fin to determine the total length of the fish. Once measurements are completed, the “save measurement” function is used to store the data automatically in an Excel sheet.

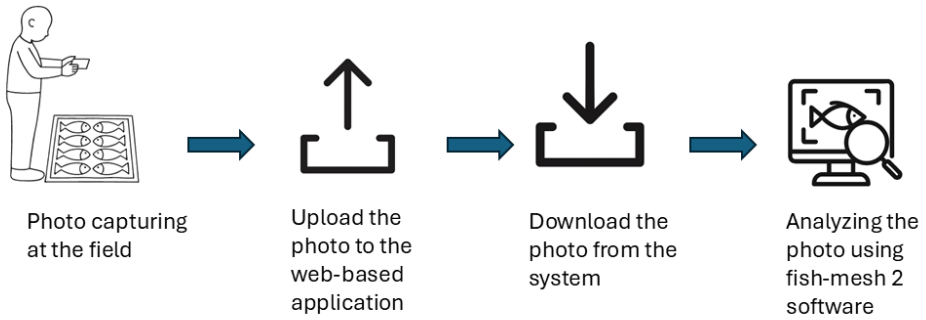

Fig.3. Schematic diagram of the photo-based method to collect fish length data

To compare fish length measurements obtained using the introduced photo-based method and the conventional manual method, samples of frigate tuna (*Auxis thazard*) were measured using both techniques at the same location. The length measurements from the two methods were statistically compared using a paired t-test in R software (R core team, 2024) to assess any significant differences. Additionally, a Bland–Altman plot was generated to evaluate the agreement between the two measurement methods (Bland and Altman,1986).

Results

The length measurement of the from the two methods are not significantly different($p > 0.05$).

Table.1. Statistical test results of paired t test for photo method and manual method for fish length measurements

Method	*Mean*	*Standard Deviation*	*t-value*	*df*	*p value*
Photo method	25.91	1.39	0.47933	21	0.637
Manual method	25.96	1.24			

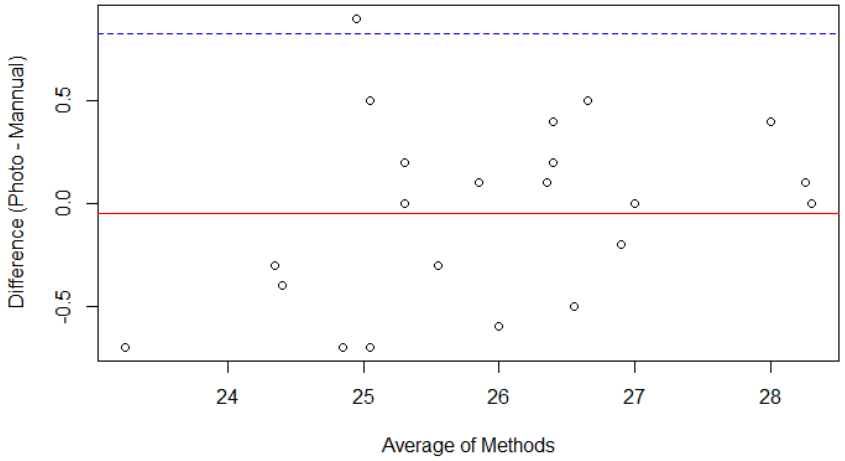

Fig.4. The Bland Altman plot for the photo-based length measurement method and manual fish length measurement

The Bland–Altman analysis showed a mean bias close to zero, indicating no consistent over- or underestimation by the photo method compared to manual measurements. Most of the differences fell within the 95% limits of agreement, confirming that the photo-based technique provides fish length estimates consistent with the manual method.

Discussion

Even though fish length measurements are crucial in fishery-dependent data collection programs, the effectiveness of such programs is often constrained by the additional handling time required. Fishermen are sometimes reluctant to allow measurements, as the process can be time-consuming and handling the fish may reduce its quality, particularly for small-sized species. Nevertheless, obtaining accurate and reliable length data is essential for developing a robust data collection framework, which in turn supports effective stock assessments and sustainable fisheries management.

The experimental results revealed no significant difference between fish length data obtained through the photo-based method and the traditional manual measurements. This finding suggests that the photo method can be effectively adopted by enumerators as an efficient and reliable alternative to manual measurement, thereby reducing handling time and improving field efficiency. Furthermore, the Bland–Altman analysis confirmed that the photo-based measurement method produces results comparable to the manual method, demonstrating a high level of agreement between the two techniques. Therefore, the photo-based method can be confidently recommended as a practical alternative for collecting fish length data in place of conventional manual measurements.

Through the development of this system, Sri Lanka aims to enhance fish length data collection in a more effective and efficient manner. The newly introduced system not only facilitates data collection by enumerators at fish landing sites but also enables researchers to gather larger datasets and improve analytical accuracy. However, several limitations were identified. The photo-based method is currently restricted to small-sized coastal tunas due to the limited dimensions of the measuring board. Additionally, photo analysis can be influenced by shadows and lighting conditions in the field, although these effects can be minimized through proper analytical practices using the FishMesh2 software. Moreover, enumerators must identify a flat surface to properly position the board and capture high-quality images for analysis.

Acknowledgement

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